

APPENDIX 4
DOD GENERIC SWITCHING CENTER REQUIREMENTS (GSCR)
08 SEP 03
Echo Cancellor (EC) Requirements

A4.1 Background

This appendix describes the requirements that must be met by all Echo Cancellor (EC) devices for them to be certified and used in the Defense Switched Network (DSN).

The requirements contained in this appendix are based on:

- a. Policy for DOD voice networks as outlined in the Chairman of Joint Chiefs of Staff Instruction (CJCSI) 6215.01B, *“Policy for Department of Defense Voice Networks”*. CJCSI 6215.01B defines the DSN as being “an interbase, nonsecure or secure C2 telecommunications system that provides end-to-end command use and dedicated telephone service, voice-band data, and dial-up VTC for C2 and non-C2 DOD authorized users in accordance with national security directives.” The CJCS instruction further specifies the need for the DSN to offer military unique features (MUFs) such as Multi-Level Precedence and Preemption (MLPP) and military Network Management (NM).
- b. *“Department Of Defense Voice Networks Generic Switching Center Requirements (GSCR)”*, 08 Sep 2003.
- c. Department of Defense Instruction (DODI) 8100.3, 16 January 2004, *“Department of Defense (DoD) Voice Networks”*.

A4.2 Purpose

The purpose for developing this appendix to the Defense Switch Network (DSN) Generic Switching Center Requirements (GSCR) document is to specify echo canceller requirements so they can be certified for use in the DSN. Echo cancellers are voice operated devices placed in the 4-wire portion of a circuit (which may be an individual circuit path or a path carrying a multiplexed signal) and are used for reducing the echo by subtracting an estimated echo from the circuit echo. In the DSN, ECs are implemented in a split manner, with one on each of the two sides of a transmission path. A properly designed EC does not degrade the bearer channel signal.

Echo cancellers are used to minimize echo in circuits containing hybrids that convert four- to two-wire connections. They compensate for the effect of high, end-to-end, delay that result in unacceptable voice listening performance. In general, echo cancellers are needed on long terrestrial trunks and on all trunks routed via satellite. They mitigate echo mainly by estimating the voice signal’s pattern, making a model of that pattern, storing it and subtracting it from the echo returning from the distant end, while leaving intact the information flow coming from the distant end. ECs may be implemented as stand alone devices or integrated into the transmission interfaces of switches or other network devices.

GSCR Appendix 4 – DSN EC Requirements

As a minimum, compliance to Section 1 of the GSCR is required to include the following requirements that are features and capabilities considered necessary for a particular switch type to support warfighter missions in DoD. These features and capabilities will require certification prior to introduction into the DSN.

Conditional requirements are features and capabilities that are not considered critical for DoD mission support based on DoD policies. It is however, recognized that such features do have utility for some users or for specific operations. To ensure interoperability and consistency of the Multi-Level Precedence and Preemption (MLPP) functionalities across all platforms, these features and capabilities are specified with set parameters. If these features and capabilities are provided, the device shall perform and meet the specifications as identified in this GSCR appendix.

A4.3 Applicability

This appendix applies to all echo cancellers procured or leased for installation in the DSN. All services, features and functions (both unique military and standard commercial) identified in the GSCR and its associated Appendixes are to be implemented in DSN assets including switches, trunks, lines, Customer Premises Equipment (CPE), and ancillary equipment. This appendix also applies to upgrades and new software loads for existing equipment.

The GSCR is the governing specification document that takes precedence over the explicit or implicit requirements of subsidiary or reference documents, standards, and specifications. In the event of conflict, the explicit requirements of the GSCR take precedence over the explicit or implicit requirements of the LATA Switching Systems Generic Requirements (LSSGR), Generic Requirements (GR), and DISAC 370-175-13.

A4.4 Definitions

New call: New calls are defined to be not only when a trunk is seized and used to transmit call control signaling after being in a idle state, as defined by the signaling used on the trunks that have been selected to carry the call attempt (i.e., wink for wink start trunks, IAM for SS7 trunks, etc.), but also preempts for reuse of a bearer channel, (such as a DS0 in a PCM-24 or PCM-30 transmission facility) are defined to also be a new call. Preempt for reuse of a trunk is used to support MLPP calls in the DSN (see Section 3 in the GSCR).

Required: These are features and capabilities considered necessary for devices covered by this appendix for DoD mission support based on DoD policies. These features and capabilities require certification prior to introduction into the DSN.

Conditional: These are features and capabilities that are not considered critical for DoD mission support based on DoD policies. It is recognized however, that such features do have utility for some users or for specific operations. If these features and capabilities are provided, the devices covered by this appendix shall perform and meet the specifications as identified.

A4.5 Requirements

This section provides the requirements for echo control equipment in the DSN. All echo canceller devices are required to meet the below requirements.

A4.5.1 Echo Canceller Functionality

[Required] The echo canceller shall meet the requirements of ITU-T Recommendation G.165, “*Echo cancellers*“, ITU-T Recommendation G.168 “*Digital network echo cancellers*“, and Section 7 of Telcordia Technologies SR-2275, “*Telcordia Notes on the Networks*”.

[Required] The EC shall support at least 64 ms echo tail length.

[Required] The Mean Opinion Score (MOS) technique, if applicable, and the Perceptual Evaluation of Speech Quality (PESQ) measurement, ITU-T Recommendation P.862, “*Perceptual evaluation of speech quality (PESQ), an objective method for end-to-end speech quality assessment of narrowband telephone networks and speech codecs*“, shall be used to assess the clarity of end-to-end voice circuits on which echo cancellers are installed. The voice quality shall have a mean opinion score (MOS) of 4.0 or better, as measured in accordance with JTA voice quality standards.

[Required] The EC shall be able to determine when a new call is being established and apply echo cancellation IAW this appendix.

[Required] The EC shall have at a minimum the following two operational states and they shall be settable by the Network Management system (see Section A4.5.7 of this appendix), local control interface, or front/back control panel on a per DS0 basis.

- a. Normal: Echo cancellation will remain in the enabled state between calls and during calls unless it is disabled as defined in this appendix.
- b. Forced off: In this mode, the EC shall not enable echo cancellation until the forced off state has been changed.

A4.5.2 2100 Hz Tone Disable Capability

[Required] On a per-channel basis, a 2100 Hz tone shall be recognized by the EC, causing the EC to disable, as specified in ITU-T Recommendation G.168, “*Digital network echo cancellers*”.

[Required] Re-enabling the EC, after the echo cancellation function has been disabled by the tone, it shall remain in a disabled state until one of the following events occur.

- a. No single-frequency sinusoid is present as defined in Section 7 of G.168.
- b. The end of the call is detected.

c. The end of data transmission is detected. This may be detected by either the lack of modem or fax tones on the channel or by some proprietary method.

[Required] ECs shall be capable of determining when a channel is in use (i.e., a call is active on the channel) or not. This function shall not interfere in any manner with an active call.

[Required] The 2100 Hz disabling tone shall override all other control functions and shall disable echo cancellation for that particular call.

A4.5.3 EC Hardware

[Required] The EC shall be able to be connected to analog or digital transmission facilities.

[Conditional] If an analog trunk interface is provided, then the EC shall be able to provide echo cancellation on a per-trunk basis.

[Conditional] If a digital trunk interface is provided, then the EC hardware shall be implemented on a digital basis without conversion to analog. The digital echo canceller shall treat all DS0 channels (PCM-24, PCM-30, or more for SONET) independently.

A4.5.4 Echo Cancellation on PCM Circuits

[Required] PCM-24 or PCM-30 interfaces shall be in accordance with the requirements in Section 7 of the GSCR as applicable for the interface.

[Required] When the bearer channel is used for 56 or 64 kb/s digital data or submultiples of 64 kb/s, the digital ECs shall not cause a loss of bit integrity.

[Required] ECs inserted in a PCM-24 path utilizing channel-associated signaling (i.e., "robbed bit") shall have a selectable setting to exclude the signaling bits from the cancellation process.

[Required] The EC shall be capable of performing echo cancellation for speech and audio bearer capability calls on the full 64 kb/s signal.

[Required] Echo canceller shall not interfere with the functionality of CCS7 continuity check tones.

A4.5.5 External Echo Cancellers

[Conditional] Echo cancellers that are placed on network facilities and are not controlled by a switch or adjunct controller, shall be able to determine when a new call is a voice or data call. For voice calls, echo cancellation shall be enabled and for data calls, echo cancellation shall be disabled.

A4.5.6 Internal Echo Cancellers

[Conditional] Echo cancellers that are placed on network facilities and are controlled by a switch or adjunct controller shall enable or disable its echo cancellation capability based on input from the local switch or adjunct controller. The EC shall receive this input via a direct connection to the switch's or adjunct controller's internal messaging pathways or by using an external communications port. For voice calls, echo cancellation shall be enabled and for data calls, the echo cancellation shall be disabled.

A4.5.7 Device Management

[Required] All echo canceller devices in the DSN will be monitored and managed by the Advanced DSN Integrated Management Support System (ADMISS) as described in the GSCR Section 9. The echo canceller must be able to be centrally monitored and managed as per Sections 9.3 and 9.4 of the GSCR.

[Required] Echo cancellers shall be capable of performing a self-test diagnostic function on non-active and active channels on a noninterference basis and report any failures to the assigned NM system.

[Conditional] If the EC is not considered to be an integral part of the switch or larger functional entity, then a front or back panel and/or external console control capability shall be provided for local management.

[Required] The EC shall enable or disable its echo cancellation capability based on input from a local switch or adjunct controller. The EC shall receive this input via a direct connection to the switch's or adjunct controller's internal messaging pathways or by using an external communications port.

A4.5.8 Reliability

[Required] The EC reliability and availability shall conform to Section 5 of Telcordia Technologies Generic Requirements GR-512-CORE, "*LSSGR: Reliability, Section 12*", Issue 2, January 1998 as specified for individual devices. The vendor shall provide a reliability model for the system, showing all calculations and showing also how the overall availability will be met, if requested.

A4.5.9 Security

[Required] If the EC is not considered to be an integral part of the switch, then it shall conform to the requirements outlined in Department of Defense Instruction (DODI) 5200.40, 30 December 1997, "*Defense Information Technology Security Certification and Accreditation Process (DITSCAP)*" and the DSN Security Technical Implementation Guide. Otherwise, the switch is responsible for the adherence to the above mentioned requirements.

A4.6 EC Application Guidelines

This section describes the application of EC devices in the DSN and is for information only.

The need for echo control devices becomes apparent as the round trip delay of the facilities used totals more than 30 ms. An EC is actually required at both ends of the PCM or analog transmission system when the round trip delay is greater than 20 ms. While round-trip delays of less than 30 ms are tolerable to normal telephonic speech and not perceived by the user as an echo condition, this quantity of delay results in a noticeable "hollowness" to the circuit, as though the caller were talking in a reverberant room or tunnel. If the DSN were only a fraction of its current size and complexity, individual trunks that cause the delay could be singled out and provided with echo control. But because of the complexity of all possible connections in a global switched network, the delay introduced by digital processing, and the physics of how an EC functions, a different approach must be taken.

A4.6.1 EC Placement

ECs are placed on the (see Figure A4.1 - Echo Canceller Applications in the DSN):

- a. Multi-Function Switch (MFS) end of all circuits interconnecting with MFSs or Stand-Alone Switches (SAS). This configuration allows for the echo cancellation for calls terminating on the MFS or calls terminating at close-in (less than 300 miles distant) End Offices (EO) or Private Branch Exchanges (PBX).
- b. The Tandem Switch end of all circuits interconnecting EOs or PBXs with the SAS.
- c. Both ends of all circuits over 300 miles in length interconnecting EOs or PBXs with either MFSs or SASs.
- d. The MFS/EO/PBX end of all circuits interconnecting with networks other than the DSN.

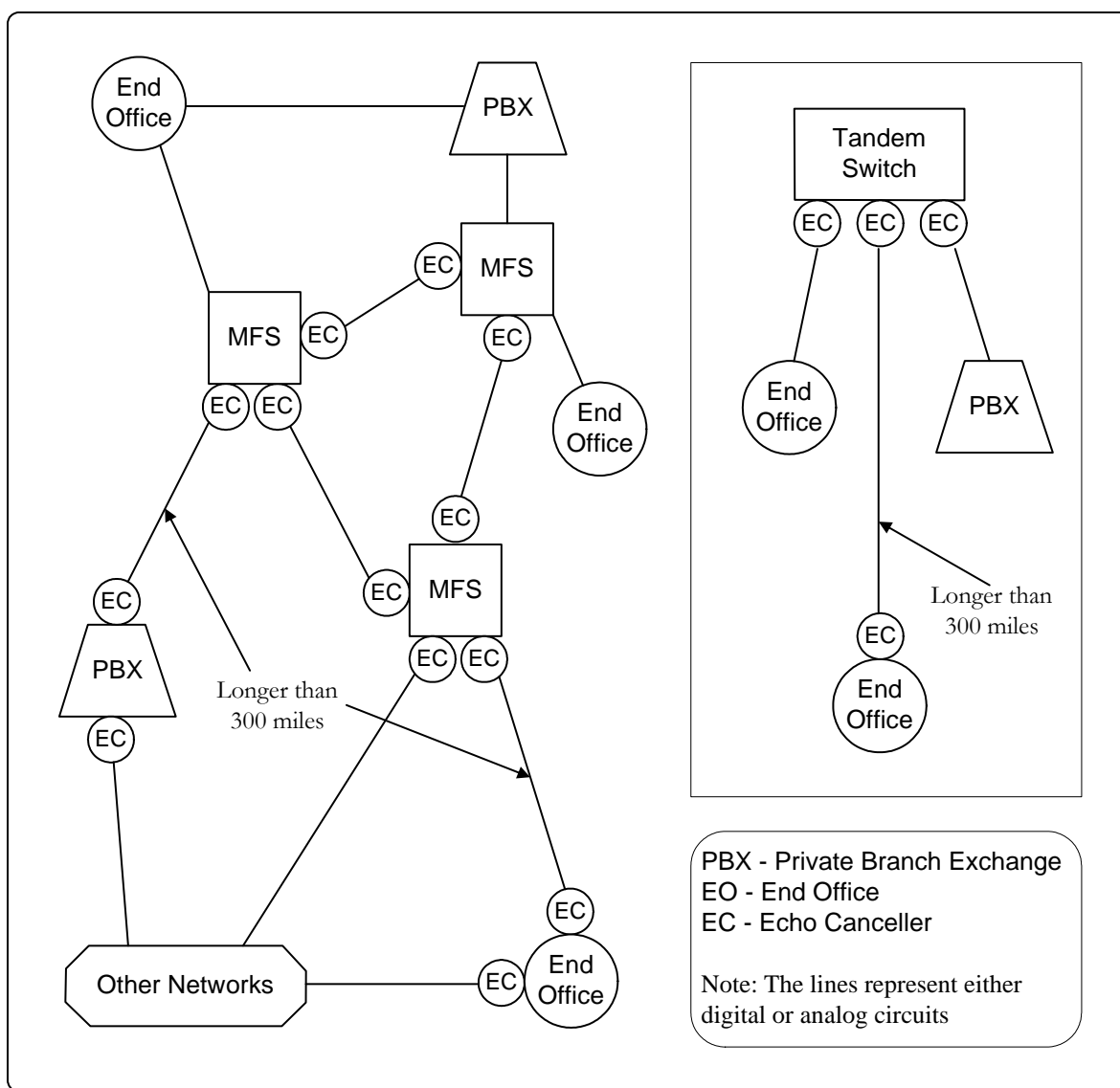


Figure A4.1 - Echo Celler Applications in the DSN

A4.6.2 Additional Guidance

EO and PBX ECs need minimum (typically 8 ms) End Path Delay Capability. Each MFS configuration requires that the End Path Delay be computed for all subtending EOs and PBXs (other than those providing their own ECs under the 300 mile rule). An End Path Delay Capability greater than the highest End Path Delay figure (from the computations) will be standard for all ECs on a particular MFS.

A4.6.3 Exceptions

Best engineering judgment may be applied to EC placement in special cases where numerous MFSs are in close proximity and the provisioning of ECs on all MFS-to-MFS trunks is not cost effective. However, placing ECs only on egress circuits to a DSN switch cluster or enclave

GSCR Appendix 4 – DSN EC Requirements

increases the end path delay capability required for the "gateway" ECs. The possibility of intra-enclave circuit tandeming between the EC and the furthest possible (in terms of delay) enclave hybrid complicates the determination of required end path delay capability. The added complexity is due to the numerous possible intra-enclave paths and the cumulative delay of a series of switches, multiplexers, etc. If the longest (in terms of delay) possible end path delay route is not accurately identified, the end path delay capability calculated may be too small to effectively cancel echo for all possible circuit connections.